

091889745



PATENT COOPERATION TREATY

PCT

From the INTERNATIONAL BUREAU

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

To:

GRIFFITH HACK
3rd floor
509 St. Kilda Road
Melbourne, VIC 3004
AUSTRALIE

Date of mailing (day/month/year) 28 August 2001 (28.08.01)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference	
International application No. PCT/AU00/00030	International filing date (day/month/year) 20 January 2000 (20.01.00)

1. The following indications appeared on record concerning:

☒ the applicant

 ☐ the inventor

 ☐ the agent

 ☐ the common representative

Name and Address ODYSSEY TECHNOLOGY PTY LTD Room 5217 Level 2 Hawken Engineering Building University of Queensland Brisbane, QLD 4072 Australia	State of Nationality **	State of Residence AU
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person

 ☐ the name

 ☐ the address

 ☒ the nationality

 ☐ the residence

Name and Address ODYSSEY TECHNOLOGY PTY LTD Room 5217 Level 2 Hawken Engineering Building University of Queensland Brisbane, QLD 4072 Australia	State of Nationality AU	State of Residence AU
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

<input checked="" type="checkbox"/> the receiving Office	<input type="checkbox"/> the designated Offices concerned
<input type="checkbox"/> the International Searching Authority	<input checked="" type="checkbox"/> the elected Offices concerned
<input type="checkbox"/> the International Preliminary Examining Authority	<input type="checkbox"/> other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Cécile CHATEL (Fax 338.87.40) Telephone No.: (41-22) 338.83.38
---	---

PATENT COOPERATION TREATY

9/889745

PCT

From the INTERNATIONAL BUREAU

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

To:

GRIFFITH HACK
3rd floor
509 St. Kilda Road
Melbourne, VIC 3004
AUSTRALIEDate of mailing (day/month/year)
27 juillet 2001 (27.07.01)

Applicant's or agent's file reference

IMPORTANT NOTIFICATION

International application No.
PCT/AU00/00030International filing date (day/month/year)
20 janvier 2000 (20.01.00)

1. The following indications appeared on record concerning:

☒ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address

TERRATEC ASIA-PACIFIC PTY. LTD.
"Huntingfield Industrial Estate"
Lot 17
Patriarch Drive
Kingston, TAS 7050
Australia

State of Nationality

AU

State of Residence

AU

Telephone No.

Facsimile No.

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☒ the person ☒ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address

ODYSSEY TECHNOLOGY PTY LTD
Room 5217
Level 2
Hawken Engineering Building
University of Queensland
Brisbane, QLD 4072
Australia

State of Nationality

**

State of Residence

AU

Telephone No.

Facsimile No.

Teleprinter No.

3. Further observations, if necessary:

Please note that the applicant identified in Box 1 has assigned his rights to the applicant identified in Box 2.

4. A copy of this notification has been sent to:

☒ the receiving Office ☐ the designated Offices concerned
☐ the International Searching Authority ☒ the elected Offices concerned
☐ the International Preliminary Examining Authority ☒ other: TERRATEC ASIA-PACIFIC PTY LTDThe International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Authorized officer

Cécile Chatel (Fax 338.87.40)

Facsimile No.: (41-22) 740.14.35

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark
Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 15 September 2000 (15.09.00)	
International application No. PCT/AU00/00030	Applicant's or agent's file reference
International filing date (day/month/year) 20 January 2000 (20.01.00)	Priority date (day/month/year) 20 January 1999 (20.01.99)
Applicant PEACH, Anthony, John et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

09 August 2000 (09.08.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Charlotte ENGER Telephone No.: (41-22) 338.83.38
---	---

* The demand must be filed directly with the competent International Preliminary Examining Authority or, if two or more Authorities are competent, with the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line below:

IPEA/ _____

PCT

CHAPTER II

DEMAND

under Article 31 of the Patent Cooperation Treaty:
The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty and hereby elects all eligible States (except where otherwise indicated).

For International Preliminary Examining Authority use only	
Identification of IPEA	Date of receipt of DEMAND
Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION	
Applicant's or agent's file reference FP12181	
International application No. PCT/AU00/00030	International filing date (day/month/year) (20/01/00) 20 January 2000
(Earliest) Priority date (day/month/year) (20/01/99) 20 January 1999	
Title of invention ROCK BORING DEVICE	
Box No. II APPLICANT(S)	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)	
TERRATEC ASIA-PACIFIC PTY LTD (ACN 050 205 617) "HUNTINGFIELD INDUSTRIAL ESTATE" LOT 17, PATRIARCH DRIVE KINGSTON, TASMANIA 7050 AUSTRALIA	
Telephone No.: 03 6229 5511	
Facsimile No.: 03 6229 5700	
Teleprinter No.:	
State (that is, country) of nationality: AUSTRALIA	State (that is, country) of residence: AUSTRALIA
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)	
PEACH, Anthony John 36 TALONE ROAD BLACKMANS BAY, TASMANIA 7052 AUSTRALIA	
State (that is, country) of nationality: AUSTRALIA	State (that is, country) of residence: AUSTRALIA
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)	
JONES, Alwyn Arthur 19 PEARL PLACE BLACKMANS BAY, TASMANIA 7052 AUSTRALIA	
State (that is, country) of nationality: AUSTRALIA	State (that is, country) of residence: AUSTRALIA
<input checked="" type="checkbox"/> Further applicants are indicated on a continuation sheet.	

Continuation of Box No. II APPLICANT(S)	
<i>If none of the following sub-boxes is used, this sheet should not be included in the demand.</i>	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) JURASOVIC, Anton Josep 30 SINCLAIR AVENUE WEST MOONAH, TASMANIA 7009 AUSTRALIA	
State (that is, country) of nationality: AUSTRALIA	State (that is, country) of residence: AUSTRALIA
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) JOHNSTONE, Geoffrey Peter 836 SANDY BAY ROAD SANDY BAY, TASMANIA 7005 AUSTRALIA	
State (that is, country) of nationality: AUSTRALIA	State (that is, country) of residence: AUSTRALIA
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) CUSICK, Wayne Anthony 13 TANUNDAL STREET HOWRAH, TASMANIA 7018 AUSTRALIA	
State (that is, country) of nationality: AUSTRALIA	State (that is, country) of residence: AUSTRALIA
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) SUGDEN, David Burnett 33 KINGSTON HEIGHTS KINGSTON BEACH, TASMANIA 7050 AUSTRALIA	
State (that is, country) of nationality: AUSTRALIA	State (that is, country) of residence: AUSTRALIA
<input type="checkbox"/> Further applicants are indicated on another continuation sheet.	

Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCEThe following person is ☒ agent ☐ common representativeand ☒ has been appointed earlier and represents the applicant(s) also for international preliminary examination.☐ is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.☐ is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.Name and address: *(Family name followed by given name; for a legal entity, full official designation.
The address must include postal code and name of country.)*GRIFFITH HACK
3RD FLOOR
509 ST. KILDA ROAD
MELBOURNE, VICTORIA 3004
AUSTRALIA

Telephone No.:

03 9243 8300

Facsimile No.:

03 9243 8333/4

Teleprinter No.:

AA30921

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.**Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION****Statement concerning amendments:***

1. The applicant wishes the international preliminary examination to start on the basis of:

☒ the international application as originally filed

the description

☐ as originally filed☐ as amended under Article 34

the claims

☐ as originally filed☐ as amended under Article 19 (together with any accompanying statement)☐ as amended under Article 34

the drawings

☐ as originally filed☐ as amended under Article 342. ☐ The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.3. ☐ The applicant wishes the start of the international preliminary examination to be postponed until the expiration of 20 months from the priority date unless the International Preliminary Examining Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule 69.1(d)). *(This check-box may be marked only where the time limit under Article 19 has not yet expired.)*

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Language for the purposes of international preliminary examination: ENGLISH☒ which is the language in which the international application was filed.☐ which is the language of a translation furnished for the purposes of international search.☐ which is the language of publication of the international application.☐ which is the language of the translation (to be) furnished for the purposes of international preliminary examination.**Box No. V ELECTION OF STATES**The applicant hereby elects all eligible States *(that is, all States which have been designated and which are bound by Chapter II of the PCT)*

excluding the following States which the applicant wishes not to elect:

Box No. VI CHECK LIST

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination:

- | | | |
|--|---|--------|
| 1. translation of international application | : | sheets |
| 2. amendments under Article 34 | : | sheets |
| 3. copy (or, where required, translation) of amendments under Article 19 | : | sheets |
| 4. copy (or, where required, translation) of statement under Article 19 | : | sheets |
| 5. letter | : | sheets |
| 6. other (<i>specify</i>) | : | sheets |

For International Preliminary Examining Authority use only

received not received

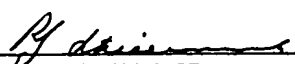
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

The demand is also accompanied by the item(s) marked below:

- | | |
|--|---|
| 1. <input checked="" type="checkbox"/> fee calculation sheet | 4. <input type="checkbox"/> statement explaining lack of signature |
| 2. <input type="checkbox"/> separate signed power of attorney | 5. <input type="checkbox"/> nucleotide and or amino acid sequence listing in computer readable form |
| 3. <input type="checkbox"/> copy of general power of attorney; reference number, if any: | 6. <input type="checkbox"/> other (<i>specify</i>): |

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).


R J STRICKLAND
for and on behalf of GRIFFITH HACK
Agents for the Applicants

For International Preliminary Examining Authority use only

1. Date of actual receipt of DEMAND:

2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):

3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply.

☐ The applicant has been informed accordingly.

4. ☐ The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5.

5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.

For International Bureau use only

Demand received from IPEA on:

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

receiving Office use only
International Application No.
International Filing Date
Name of receiving Office and "PCT International Application"
Applicant's or agent's file reference (if desired) (12 characters maximum)

Box No. I TITLE OF INVENTION ROCK BORING DEVICE	
Box No. II APPLICANT	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)	
TERRATEC ASIA-PACIFIC PTY LTD (ACN 050 205 617) "HUNTINGFIELD INDUSTRIAL ESTATE" LOT 17, PATRIARCH DRIVE KINGSTON, TASMANIA 7050 AUSTRALIA	
<input type="checkbox"/> This person is also inventor.	
Telephone No. 03 6229 5511	
Facsimile No. 03 6229 5700	
Teleprinter No.	
State (that is, country) of nationality: AUSTRALIA	State (that is, country) of residence: AUSTRALIA
This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input checked="" type="checkbox"/> all designated States except the United States of America <input type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box	
Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)	
PEACH, Anthony John 36 TALONE ROAD BLACKMANS BAY, TASMANIA 7052 AUSTRALIA	
This person is: <input type="checkbox"/> applicant only <input checked="" type="checkbox"/> applicant and inventor <input type="checkbox"/> inventor only (If this check-box is marked, do not fill in below.)	
State (that is, country) of nationality: AUSTRALIA	State (that is, country) of residence: AUSTRALIA
This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input checked="" type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box	
<input checked="" type="checkbox"/> Further applicants and/or (further) inventors are indicated on a continuation sheet.	
Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE	
The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: <input checked="" type="checkbox"/> agent <input type="checkbox"/> common representative	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)	
GRIFFITH HACK 3RD FLOOR 509 ST. KILDA ROAD MELBOURNE, VICTORIA 3004 AUSTRALIA	
Telephone No. 03 9243 8300	
Facsimile No. 03 9243 8333/4	
Teleprinter No. AA30921	
<input type="checkbox"/> Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.	

Continuation of Box No. III - FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

JONES, Alwyn Arthur
19 PEARL PLACE
BLACKMANS BAY, TASMANIA 7052
AUSTRALIA

This person is:

- ☐ applicant only
☒ applicant and inventor
☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

AUSTRALIA

State (that is, country) of residence:

AUSTRALIA

This person is applicant for the purposes of:

- ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

JURASOVIC, Anton Josep
30 SINCLAIR AVENUE
WEST MOONAH, TASMANIA 7009
AUSTRALIA

This person is:

- ☐ applicant only
☒ applicant and inventor
☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

AUSTRALIA

State (that is, country) of residence:

AUSTRALIA

This person is applicant for the purposes of:

- ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

JOHNSTONE, Geoffrey Peter
836 SANDY BAY ROAD
SANDY BAY, TASMANIA 7005
AUSTRALIA

This person is:

- ☐ applicant only
☒ applicant and inventor
☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

AUSTRALIA

State (that is, country) of residence:

AUSTRALIA

This person is applicant for the purposes of:

- ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

CUSICK, Wayne Anthony
13 TANUNDAL STREET
HOWRAH, TASMANIA 7018
AUSTRALIA

This person is:

- ☐ applicant only
☒ applicant and inventor
☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

AUSTRALIA

State (that is, country) of residence:

AUSTRALIA

This person is applicant for the purposes of:

- ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on another continuation sheet.

Continuation of Box No. 11 FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

SUGDEN, David Burnett
33 KINGSTON HEIGHTS
KINGSTON BEACH, TASMANIA 7050
AUSTRALIA

This person is:

- ☐ applicant only
☒ applicant and inventor
☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

AUSTRALIA

State (that is, country) of residence:

AUSTRALIA

This person is applicant for the purposes of:

- ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

- ☐ applicant only
☐ applicant and inventor
☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant for the purposes of:

- ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

- ☐ applicant only
☐ applicant and inventor
☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant for the purposes of:

- ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

- ☐ applicant only
☐ applicant and inventor
☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant for the purposes of:

- ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes; at least one must be marked):

Regional Patent

- ☒ AP ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SL Sierra Leone, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

National Patent (if other kind of protection or treatment desired, specify on dotted line):

- | | |
|--|--|
| <input checked="" type="checkbox"/> AE United Arab Emirates | <input checked="" type="checkbox"/> LR Liberia |
| <input checked="" type="checkbox"/> AL Albania | <input checked="" type="checkbox"/> LS Lesotho |
| <input checked="" type="checkbox"/> AM Armenia | <input checked="" type="checkbox"/> LT Lithuania |
| <input checked="" type="checkbox"/> AT Austria | <input checked="" type="checkbox"/> LU Luxembourg |
| <input checked="" type="checkbox"/> AU Australia | <input checked="" type="checkbox"/> LV Latvia |
| <input checked="" type="checkbox"/> AZ Azerbaijan | <input checked="" type="checkbox"/> MD Republic of Moldova |
| <input checked="" type="checkbox"/> BA Bosnia and Herzegovina | <input checked="" type="checkbox"/> MG Madagascar |
| <input checked="" type="checkbox"/> BB Barbados | <input checked="" type="checkbox"/> MK The former Yugoslav Republic of Macedonia |
| <input checked="" type="checkbox"/> BG Bulgaria | <input checked="" type="checkbox"/> CR Costa Rica |
| <input checked="" type="checkbox"/> BR Brazil | <input checked="" type="checkbox"/> MN Mongolia |
| <input checked="" type="checkbox"/> BY Belarus | <input checked="" type="checkbox"/> MW Malawi |
| <input checked="" type="checkbox"/> CA Canada | <input checked="" type="checkbox"/> MX Mexico |
| <input checked="" type="checkbox"/> CH and LI Switzerland and Liechtenstein | <input checked="" type="checkbox"/> NO Norway |
| <input checked="" type="checkbox"/> CN China | <input checked="" type="checkbox"/> NZ New Zealand |
| <input checked="" type="checkbox"/> CU Cuba | <input checked="" type="checkbox"/> PL Poland |
| <input checked="" type="checkbox"/> CZ Czech Republic | <input checked="" type="checkbox"/> PT Portugal |
| <input checked="" type="checkbox"/> DE Germany | <input checked="" type="checkbox"/> RO Romania |
| <input checked="" type="checkbox"/> DK Denmark | <input checked="" type="checkbox"/> RU Russian Federation |
| <input checked="" type="checkbox"/> EE Estonia | <input checked="" type="checkbox"/> SD Sudan |
| <input checked="" type="checkbox"/> ES Spain | <input checked="" type="checkbox"/> SE Sweden |
| <input checked="" type="checkbox"/> FI Finland | <input checked="" type="checkbox"/> SG Singapore |
| <input checked="" type="checkbox"/> GB United Kingdom | <input checked="" type="checkbox"/> SI Slovenia |
| <input checked="" type="checkbox"/> GD Grenada | <input checked="" type="checkbox"/> SK Slovakia |
| <input checked="" type="checkbox"/> GE Georgia | <input checked="" type="checkbox"/> SL Sierra Leone |
| <input checked="" type="checkbox"/> GH Ghana | <input checked="" type="checkbox"/> TJ Tajikistan |
| <input checked="" type="checkbox"/> GM Gambia | <input checked="" type="checkbox"/> TM Turkmenistan |
| <input checked="" type="checkbox"/> HR Croatia | <input checked="" type="checkbox"/> TR Turkey |
| <input checked="" type="checkbox"/> HU Hungary | <input checked="" type="checkbox"/> TT Trinidad and Tobago |
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Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)

Box No. VI PRIORITY CLAIM		<input type="checkbox"/> Further priority claims are indicated in the Supplemental Box.		
Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application: regional Office	international application: receiving Office
item (1) 20/01/99 — 20 JANUARY 1999	PP8224	AUSTRALIA		
item (2)				
item (3)				

☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s): P8224

* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) (if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):

Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority):

Date (day/month/year) Number Country (or regional Office)

ISA/

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following number of sheets:

request : 6
description (excluding sequence listing part) : 12
claims : 2
abstract : 1
drawings : 6
sequence listing part of description : xx
Total number of sheets : 27

This international application is accompanied by the item(s) marked below:

1. ☐ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other (specify):

Figure of the drawings which should accompany the abstract:

3

Language of filing of the international application:

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

TONY PEACH
MANAGING DIRECTOR, AUTHORISED SIGNATORY OF
TERRATEC ASIA-PACIFIC PTY LTD

For receiving Office use only

1. Date of actual receipt of the purported international application:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority (if two or more are competent): ISA/

6. ☐ Transmittal of search copy delayed until search fee is paid.

2. Drawings:

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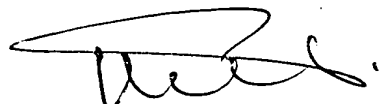
See Notes to the request form

1. If, in any of the Boxes, the space is insufficient to furnish all the information: in such case, write "Continuation of Box No. ..." [indicate the number of the Box] and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient, in particular:

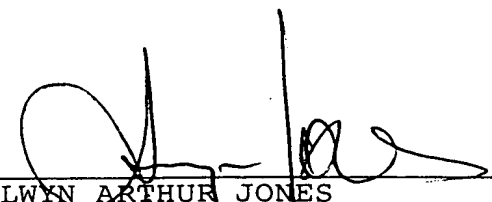
- (i) if more than two persons are involved as applicants and/or inventors and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below;
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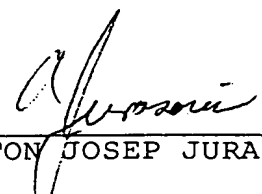
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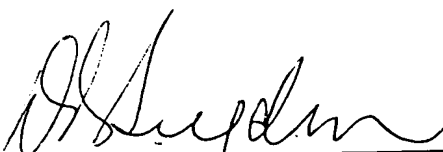

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

15

Applicant's or agent's file reference FP12181	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International application No. PCT/AU00/00030	International filing date (day/month/year) 20 January 2000	Priority Date (day/month/year) 20 January 1999
International Patent Classification (IPC) or national classification and IPC Int. Cl. ⁷ E21D 9/10		
Applicant TERRATEC ASIA PACIFIC PTY LTD et al		

1.	This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2.	This REPORT consists of a total of 3 sheets, including this cover sheet. <input type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT). These annexes consist of a total of sheet(s).
3.	This report contains indications relating to the following items: I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application

Date of submission of the demand 9 August 2000	Date of completion of the report 12 September 2000
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer DAVID LEE  Telephone No. (02) 6283 2107

I. Basis of the report

1. With regard to the **elements** of the international application:*
- ☒ the international application as originally filed.
- ☐ the description, pages , as originally filed,
 pages , filed with the demand,
 pages , received on with the letter of
- ☐ the claims, pages , as originally filed,
 pages , as amended (together with any statement) under Article 19,
 pages , filed with the demand,
 pages , received on with the letter of
- ☐ the drawings, pages , as originally filed,
 pages , filed with the demand,
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- ☐ the sequence listing part of the description:
 pages , as originally filed
 pages , filed with the demand
 pages , received on with the letter of
2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language which is:
- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
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3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, was on the basis of the sequence listing:
- ☐ contained in the international application in written form.
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- ☐ furnished subsequently to this Authority in written form.
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- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished
4. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/fig.
5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims 1-13	YES
	Claims	NO
Inventive step (IS)	Claims 1-13	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-13	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

AU 41965/72, US 5575537, GB 2252576, EP 692612.

Novelty & Inventive step - Claims 1- 13

Claim 1 defines a rock boring device with a rotary disc cutter driven in an oscillating manner, and also nutating, ie nodding. The citations define disc and other cutters that are oscillatory and/or rotary eccentrically driven. The nutating (nodding) arrangement of the current invention is a different structure and process from the rotary eccentrically driven prior art arrangements. Hence, I would consider the claims are novel and have an inventive step.



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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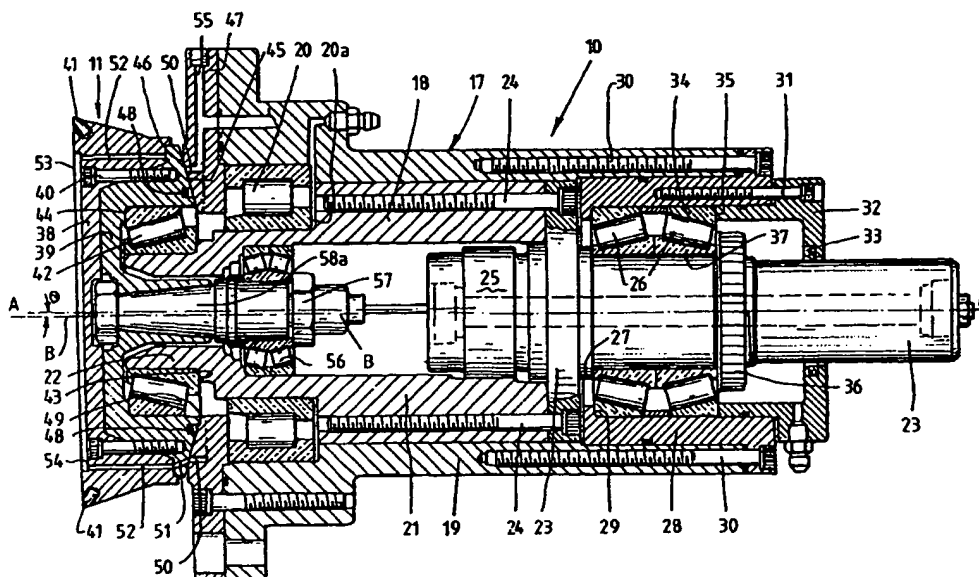
(74) Agent: GRIFFITH HACK; 3rd floor, 509 St. Kilda Road, Melbourne, VIC 3004 (AU).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published

With international search report.

(54) Title: ROCK BORING DEVICE



(57) Abstract

A rock boring device (10) including a rotary disc cutter (11). The disc cutter (11) is driven in an oscillating manner and also driven or free to nutate, and the device includes a mounting section (22) for the rotary disc cutter and a driven section (21), and wherein the mounting section (22) is angularly offset from the axis of the driven section whereby the rotary disc cutter will both oscillate and nutate.

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ROCK BORING DEVICE

Technical Field

The present invention relates to a boring device for creating bore holes in rock, or removing rock from a surface. (For example the floor of a quarry).

Background Art

Boring of holes in rock faces can be conducted in a variety of ways. For example, explosive boring, as the name suggests, involves drilling in the rock face a central primary hole and a series of secondary holes about the primary hole. The secondary holes have a diameter suitable to receive an explosive charge, while the primary holes provides an opening in the rock towards which cracks that are formed in the rock after detonation of the explosive, can propagate. The primary hole is normally of a greater diameter than the secondary holes. Cracks that propagate from the secondary holes to the primary hole create rock chips or segments, that can be separated from the rock being bored and which are thereafter removed, leaving behind a bore hole. The size of the bore hole required determines the number of primary and secondary holes needed, while each explosive detonation can only remove a certain amount of rock, so that the above process may have to be repeated several times to form a bore hole of sufficient cross section and length. As can easily be appreciated this method of boring can be quite dangerous due to the use of explosive material, while it is also time consuming and complicated to prepare the primary and secondary holes in the rock face. Additionally detonation of the explosives is a skilful exercise, as each explosive is detonated separately and at different times, to achieve the greatest extent of crack propagation.

A different form of rock boring involves the use of roller cutters that are rotationally forced into impact with the rock to again create cracks that propagate through

- 2 -

the rock. The roller cutters employ a plurality of cutting tips, arranged at a variety of different diameters, which are forced into engagement with the rock surface adjacent one another, so that cracks are formed by one cutting tip propagate and intersect with cracks formed by an adjacent tip, thus created a rock chip or segment that can be separated from the rock under the impact of the roller cutter. Applying immense compressive forces to the rock creates the cracks, and eventually a balancing tensile failure occurs. Boring devices of this kind are subject to extensive impact loading because the cutting tips are forced into engagement with the rock under large loads in order to generate the cracks in the rock and thus the rock boring device is required to have facility for large impact absorption. The impact absorption is provided by way of a huge absorption mass attached to the device and the mass is of such a size, that known boring devices can weigh many hundreds of tonnes, a substantial component of which is for impact absorption. As a consequence, the weight and size of these devices makes them expensive to construct and operate.

Disclosure of the Invention

It is an object of the following invention to overcome, or at least reduce one or more of the disadvantages associated with prior art boring devices. It is a further object of the invention to provide a mechanical device of a rotary cutting type, that provides improved rock removal from a rock face to form a rock bore and which is relatively economical to manufacture and operate. The cross section of this bore may be circular, or a polygon, or a planar surface. (Longwall in Coal or a quarry floor).

A rock boring device according to the present invention includes a rotary disc cutter, that in use, is either inserted into a pilot opening formed in the rock

- 3 -

face, or approaches the rock face at an angle to enable entry.

For this cutting action to be initiated the tip
5 of the disc should initially contact the rock at significant angle. (Probably in excess of 45°, but differing rock types or conditions may reduce or increase this requirement).

10 The boring device is characterised in that the disc cutter is driven in an oscillating manner, and also driven to nutate or free to nutate. The disc cutter is driven to move in this manner about separate or combined
15 oscillating and nutating axes. The nutation angle may be varied or fixed from 0° to almost 90° (Most probably less than 5°). That motion, when applied to the rock face, will cause the disc cutter to apply force to the rock that promotes cracks which propagate toward the rock face adjacent the opening. By this mechanism rock fragments or
20 chips can be separated from the rock when a crack propagates from the wall of the opening to the adjacent rock face. The crack will propagate from a pressure bulb created by the motion of the oscillation, nutation or combination of both motions. This cutting action enables
25 the rock to fail in tension rather than the current traditional compressive first then tension technique. This phenomenon significantly reduces the supporting structure mass for the proposed technology. To insure that the cutting mechanism does not move away from the rock being
30 cut, rather than cut the rock, a mass surrounding the cutter may be necessary.

Brief Description of the Drawings

Several preferred embodiments of the invention
35 will now be described with reference to the accompanying drawings, in which:

- 4 -

Figure 1 is a schematic view of the rock boring device of the preferred embodiment of the present invention and showing the manner in which it makes contact with a rock face,

5

Figure 2 is also a schematic view of the rock boring device showing the manner in which it acts to remove rock material,

10

Figure 3 is a detailed cross-sectional side elevational view of the rock boring device,

Figure 4 is a schematic side elevational view of one example of how the device may be machine mounted to achieve the creation of a bore hole,

15

Figure 5 is a plan view of the machine mounted device of Figure 4, and

20

Figure 6 is a schematic view of another example of how the device may be machine mounted to achieve the creation of a bore hole.

Best Modes for Carrying Out the Invention

25

With reference to Figures 1 and 2 of the drawings, the rock boring device 10 according to this preferred embodiment of the present invention includes a rotary disc cutter 11, that in use, is either inserted into a pilot opening formed in the rock face R, or approaches the rock face at an angle (α) to enable entry (see Figure 1).

30

For this cutting action to be initiated the tip of the disc should initially contact the rock at significant angle. (Probably in excess of 45° , [α] but differing rock types or conditions may reduce or increase this requirement).

35

- 5 -

The boring device 10 is characterised in that the disc cutter 11 is driven in an oscillating manner, and also driven to nutate or is free to nutate. The disc cutter 11 is driven to move in this manner about separate or combined
5 oscillating and nutating axes. The nutation angle (θ) may be varied or fixed from 0° to almost 90° (Most probably less than 5°). That motion, when applied to the rock face, will cause the disc cutter to apply force to the rock that promotes cracks which propagate toward the rock face
10 adjacent the opening (see Figure 2). By this mechanism rock fragments or chips 12 can be separated from the rock when a crack 13 propagates from the wall of the opening to the adjacent rock face. The crack will propagate from a pressure bulb 14 created by the motion of the oscillation, nutation or combination of both motions. This cutting
15 action enables the rock to fail in tension rather than the current traditional compressive first then tension technique. This phenomenon significantly reduces the supporting structure mass for the proposed technology.

20

Advantageously, the nutating motion of the disc cutter also lends to promote separation of the rock segments from the rock face and may assist sharpening of the contact point of the rotatably mounted disc. Because
25 the disc is rotatably mounted, during each oscillation, the disc will precess. This action provides a new portion of the consumable portion of the disc to the rock and also will assist to distribute the temperature created due to the interaction of the disc and the rock. The cutting
30 action of the tip 15 of the disc will require that the heel 16 of the disc does not contact the rock. To accomplish this a positive 'rake' angle (Ω) must be achieved. This angle may be fixed or varied depending upon the operational mechanism. This angle may also be varied depending upon
35 the rock type of characteristics. The variables being monitored by assessment of the forces within the drive mechanism and surrounding support structure, and the

- 6 -

results applied to algorithms in an allied computer control system. Depending upon the result of the interpretation of the data, the computer can act to alter angle Ω by providing a suitable signal to a electro-mechanical
5 actuator that can provide the require force to alter the angle of the disc during the cutting action.

A rock boring device according to the invention principally will bore a groove in the rock at circa the
10 diameter of the disc, and at the depth of plunge into the rock. The cutter excavates the rock by generating cracks in the rock and separating rock segments formed by the cracks. However, rock normally will also be removed by the abrasive action of the cutting tips against the rock and
15 the nutating motion of the disc cutter against the rock will also facilitate removal of rock in this manner. However, the amount of rock removed by this mechanism is relatively small. This rock is in the zone referred to previously as the pressure bulb 14.

20

Currently the pressure bulb area or disc to rock contact zone is cooled and airborne dust is controlled by the addition of low pressure water (Less than 10 Bar) applied through the disc via a series of holes. This
25 coolant could also be applied from an external source so that it is directed to contact the tip of the disc area. It may be possible to increase the performance of the system by directing high-pressure water (Probably above 200 Bar) at the pressure bulb area. This jet could be applied
30 either perpendicular to the direction of travel, or in line with the axis of travel, or any angle in between. The water jet indicated as 17 in Figure 2 may enter the crack that is propagating from the pressure bulb and apply a force in equal and all directions, thereby forcing the rock
35 chip to break to the free air side.

- 7 -

The disc cutter of the boring device preferably has a circular, rock engaging periphery, and may include a plurality of cutting tips which are removably connected to the cutter, but could be permanently connected.

5 Preferably, those tips extend from the disc cutter at or adjacent to the circular periphery thereof either radially, axially, or in a combination of both. The cutting tips can be formed of any suitable material, abrasion resistant, with inherent toughness such as tungsten carbide, alloy and
10 hardened steel, possibly ceramic or other, depending on the type of rock being bored. They can also have any suitable shape and can be fixed to the disc cutter in any suitable manner. The cutter may also be contiguous and be produced of any or a combination of the materials mentioned.

15

The oscillating movement of the disc cutter can be generated in any suitable manner. This motion may be direct mechanical means, or by poly-phase hydraulic pump and motor combination.

20

With reference to Figure 3 of the drawings the cutting device 10 includes a mounting assembly 17 as well as the rotary disc cutter 11. The mounting assembly 17 includes a mounting shaft 18 which is rotatably mounted
25 within a housing 19, that can constitute or be connected to a large mass for impact absorption. The housing 19 thus, can be formed of heavy metal or can be connected to a heavy metallic mass. The shaft 18 is mounted within the housing 19 by a bearing 20, which can be of any suitable type and
30 capacity. The bearing 20 is mounted in any suitable manner known to a person skilled in the art, such as against a stepped section 21.

The housing 19 can have any suitable
35 construction, and in one form includes a plurality of metal plates fixed together longitudinally of the shaft 18. With one such arrangement, the applicant has found that a

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plurality of iron and lead plates provides effective impact absorption based on weight and cost considerations.

5 The shaft 18 is mounted for rotating motion about
a central longitudinal axis AA. The shaft 18 includes a
driven section 21 and a mounting section 22. The driven
section 21 is connected to drive means 23 at the end
thereof remote from the mounting section by any suitable
connectors, such as heavy duty threaded fasteners 24, while
10 a seal 25 is applied between the facing surfaces of the
mounting section and the drive means.

 The drive means 23 can take any suitable form and
the means shown in Figure 3 is a shaft that may be driven
15 by a suitable engine or motor. The drive means 23 is
mounted within the housing 19 by bearings 26, which are
tapered roller bearings, although other types of bearings,
either anti friction, plain hydrostatic, or hydrodynamic,
that provide radial and axial force reaction could also be
20 employed. With one typical arrangement, the bearings 26
are mounted against a stepped section 27 of the drive means
23 and against a mount insert 28 which is also stepped at
29. The mount insert 28 is fixed by threaded connectors 30
to the housing 19, and fixed to the mount insert 28 by
25 further threaded connectors 31 is a sealing cap 32 which
seals against the drive means 23 by seals 33. The sealing
cap 32 also locates the outer race 34 of the bearings 26 by
engagement therewith at 35, while a threaded ring 36
locates the inner race 37.

30

 The mounting section 22 is provided for mounting
of the disc cutter 11 and is angularly offset from the axis
AA of the driven section 21, which generally will be
approximately normal to the rock face being excavated. The
35 axis BB of the mounting section 22 is shown in Figure 3 and
it can be seen that the offset angle θ is in the order of a
few degrees only. The magnitude of the offset angle θ

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determines the size of the oscillating and nutating movements of the disc cutter 11 and the angle θ can be arranged as appropriate. The angle θ could be zero, but the axis of the eccentric section off-set from the AA axis (Fig 3). This would provide oscillation but no nutation.

The disc cutter 11 includes an outer cutting disc 38 that is mounted on a mounting head 39 by suitable connecting means, such as threaded connectors 40. The outer cutting disc 38 could include a plurality of tungsten carbide cutting bits 41 which are fitted to the cutting disc matrix in any suitable manner. Alternatively, a tungsten carbide ring could be employed. The outer cutting disc can be removed from the cutting device for replacement or reconditioning, by removing the connectors 40.

The disc cutter 11 is rotatably mounted on the mounting section 22 of the mounting shaft 18. The disc cutter 11 is mounted by a tapered roller bearing 42, that is located by a step 43 and a wall 44 of the mounting head 39. An inclined surface 45 of the mounting head 39 is disposed closely adjacent a surface 46 of a mounting insert 47. The surfaces 45 and 46 are spaced apart with minimum clearance to allow relative rotating movement therebetween and the surfaces have a spherical curvature, the centre of which is at the intersection of the axes AA and BB.

A seal 48 is located in a recess 49 of the surface 45 to seal against leakage of lubricating fluid from between the mounting shaft 18, and the housing 19 and the disc cutter 11. A channel 50 is also provided in the surface 45 outwardly of the seal 48 and ducts 51 connect the channel 50 to a further channel 52 and a further duct 53 extends from the channel 52 to a front surface 54 of the outer cutting disc 38. Pressurised fluid can be injected into the various channels and ducts through the port 55 and that fluid is used to flush the underside of the cutting

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disc 38 as well as the relative sliding surfaces 45 and 46.

The disc cutter 11 is rotatably mounted to the mounting section 22 of the mounting shaft 18 by the tapered roller bearing 42 and by a further tapered roller bearing 56. The bearing 56 is far smaller than the bearing 42 for the reason that the large bearing 42 is aligned directly in the load path of the disc cutter and thus is subject to the majority of the cutter load. The smaller bearing 56 is provided to pre-load the bearing 42.

The bearing 56 is mounted against the inner surface of the mounting shaft 18 and the outer surface of a bearing loading facility, comprising a nut 57 and a pre-loading shaft 58. Removal of the outer cutting disc 38 provides access to the nut 57 for adjusting the pre-load of the bearing 56.

The nutating movement of the disc cutter 11, occurs simultaneously with the oscillating motion and that nutating movement is movement in which a point on the cutting edge of the disc cutter is caused to move sinusoidally, in a cyclic or continuous manner as the disc cutter rotates. This movement of the disc cutter applies an impact load to the rock surface under attack, that causes tensile failure of the rock.

The direction of impact of the disc cutter against the rock under face is reacted through the bearing 42 and the direction of the reaction force is substantially along a line extending through the bearing 42 and the smaller bearing 56.

The boring device of the invention is not restricted to a single disc cutter, but can include more than one. For example, the boring device may include three disc cutters arranged along the same plane, but at

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approximately 45° to each other. Such an arrangement can produce a bore of a particular shape, while the speed at which rock is removed is greatly increased. In this arrangement, each of the three disc cutters can be driven
5 by the one drive means, or they may be driven by separate drive means.

Alternatively with reference to Figures 4 and 5 the cutting device 10 may be mounted on a moveable boom 58
10 to enable the disc cutter 11 to be moved about the pilot opening as that opening is enlarged. In this arrangement the housing, and impact absorption mass (if provided) may also be mounted on the boom. The boom may be elevated by an actuator 59 to tilt about a horizontal axis X and
15 pivotable laterally via a turntable 63 about a vertical axis Z by extension and retraction of a pair of rams 64 and 65 extending from cradle 66 to either side of the turntable 63 and mounted on a chassis 70. The boom 58 has shaft 67 therethrough which in turn carries a connector 68 to which
20 the cutting device 11 is pivotably connected at W. The shaft 67 can rotate about its longitudinal axis Y. As a consequence of the pivot axes W, X, Y and Z, the cutting device can be positioned through a whole range of orientations including over one arc dictated by a short
25 radius R_1 about pivot axis W and an arc dictated by a larger radius R_2 about pivot axes X and Z. The entire assembly would be anchored by a clamping means. This may be by vertical anchoring, horizontal anchoring or by application of a mass or adhesive mechanism to ensure the
30 entire vehicle is in a finite position prior to commencing the first cut. Subsequent cuts at the rock face must be referenced to the previous cut to ensure a predetermined depth of cut is maintained. To increase the depth of cut beyond the design limit will cause the surrounding
35 mechanism to engage the rock and stall or cease the cutting action.

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This indexing and the geometry to cut the face can be composed by computer control in order to provide appropriate speed of operation.

5 With reference to Figure 6 of the drawings, in a still further arrangement, a pair of boring devices 10 may be mounted on separate booms 60 and the disc cutters are swept in an arc across the rock face and about pivot points 69, to continually remove successive layers of rock from
10 the face. The entire machine platform 61 must be securely anchored within the bore by gripping mechanisms 62.

 The disc cutters of each device is arranged to sweep in an arc across the rock face being excavated in a
15 first direction D_1 and having completed that sweep, return in the reverse direction D_2 , with each sweep of the disc cutters removing a layer of the rock face. Entrance of the disc cutters into the rock for each successive pass, may be at the cusp C between adjacent concave sections formed by
20 the sweep of each disc cutter.

 The complete machine for the purpose of excavating a tunnel should be mobile and may be mounted on a crawler or on wheels. Providing the carrier or
25 supporting vehicle will fit into the hole size selected, the opening in the rock can be from completely circular at the minimum end of the cutting shape spectrum, to somewhat ovoid. However most customers currently prefer to have a flat floor to enable them to operate subsequent vehicles.

CLAIMS:

1. A rock boring device including a rotary disc cutter, wherein the disc cutter is driven in an oscillating manner and also driven or free to nutate.
2. A rock boring device as claimed in Claim 1, wherein the device includes a mounting section for the rotary disc cutter and a driven section, and wherein the mounting section is angularly offset from the axis of the driven section whereby the rotary disc cutter will both oscillate and nutate.
3. A rock boring machine, incorporating a rock boring device as claimed in either Claim 1 or 2, wherein the rock boring device is mounted on a boom.
4. A rock boring machine as claimed in Claim 3, wherein the boom is adapted to pivot about a vertical axis.
5. A rock boring machine as claimed in Claim 3 or 4, wherein the boom is adapted to pivot about a horizontal axis.
6. A rock boring machine as claimed in Claim 3 or 4, wherein the rock boring device is supported by said boom whereby as to be pivotable about an axis extending longitudinally of said boom.
7. A rock boring machine as claimed in any one of Claims 3 to 6, wherein the rock boring device is supported to pivot relative to said boom.
8. A rock boring device substantially as hereinbefore described with reference to Figures 1 to 3 of the accompanying drawings.

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9. A rock boring machine incorporating a rock boring device as claimed in Claim 8.

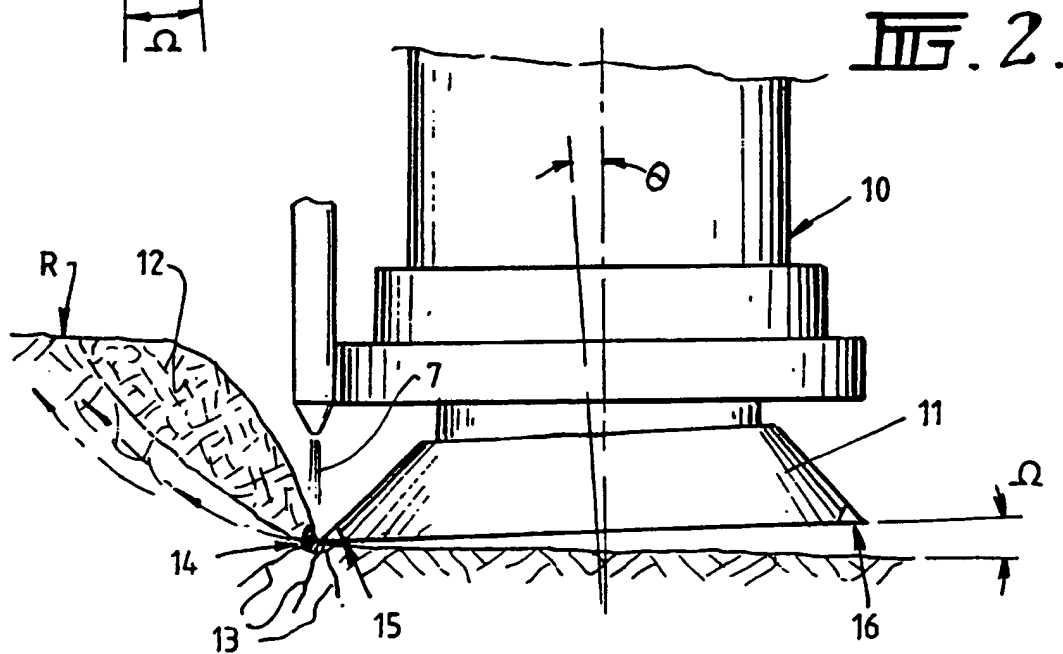
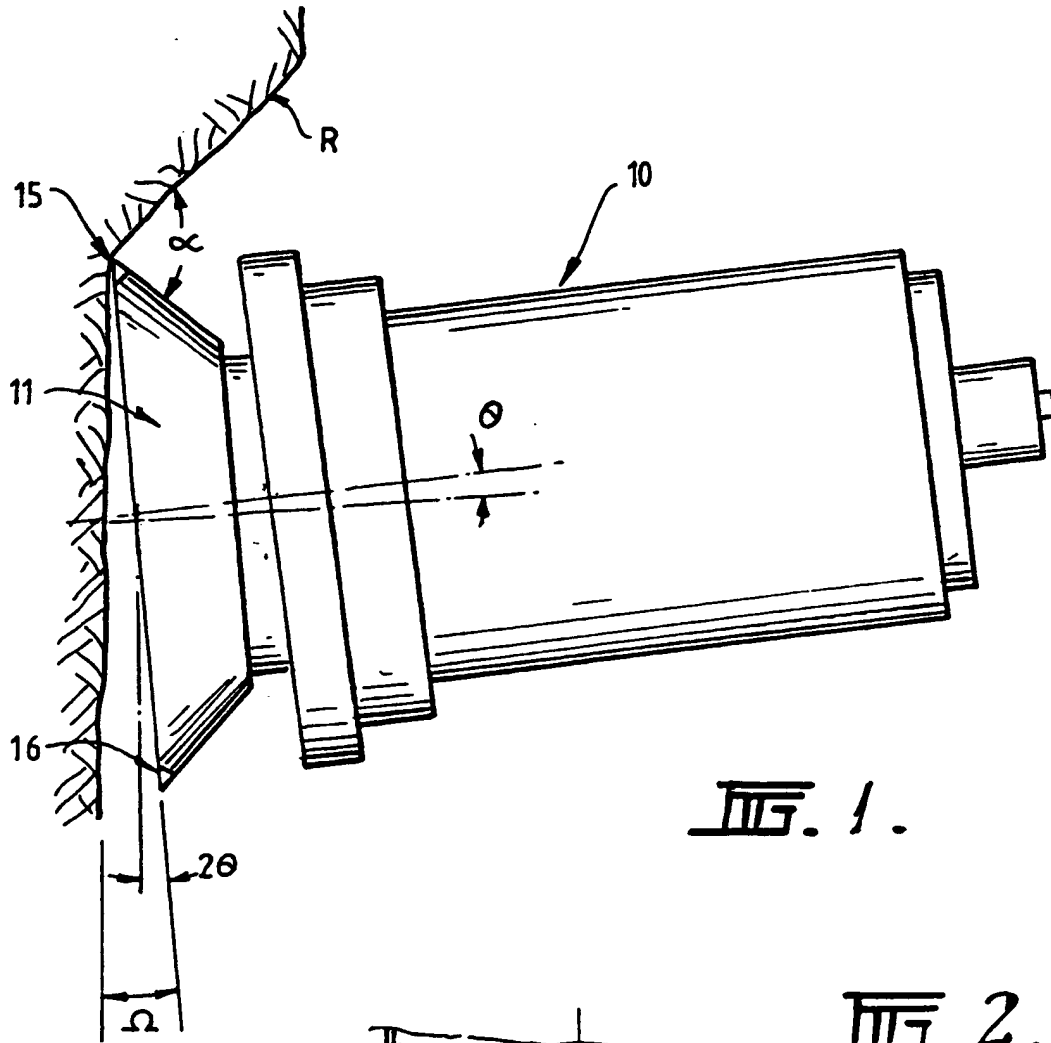
10. A rock boring machine substantially as hereinbefore described with reference to Figures 4 and 5, or Figure 6, of the accompanying drawings.

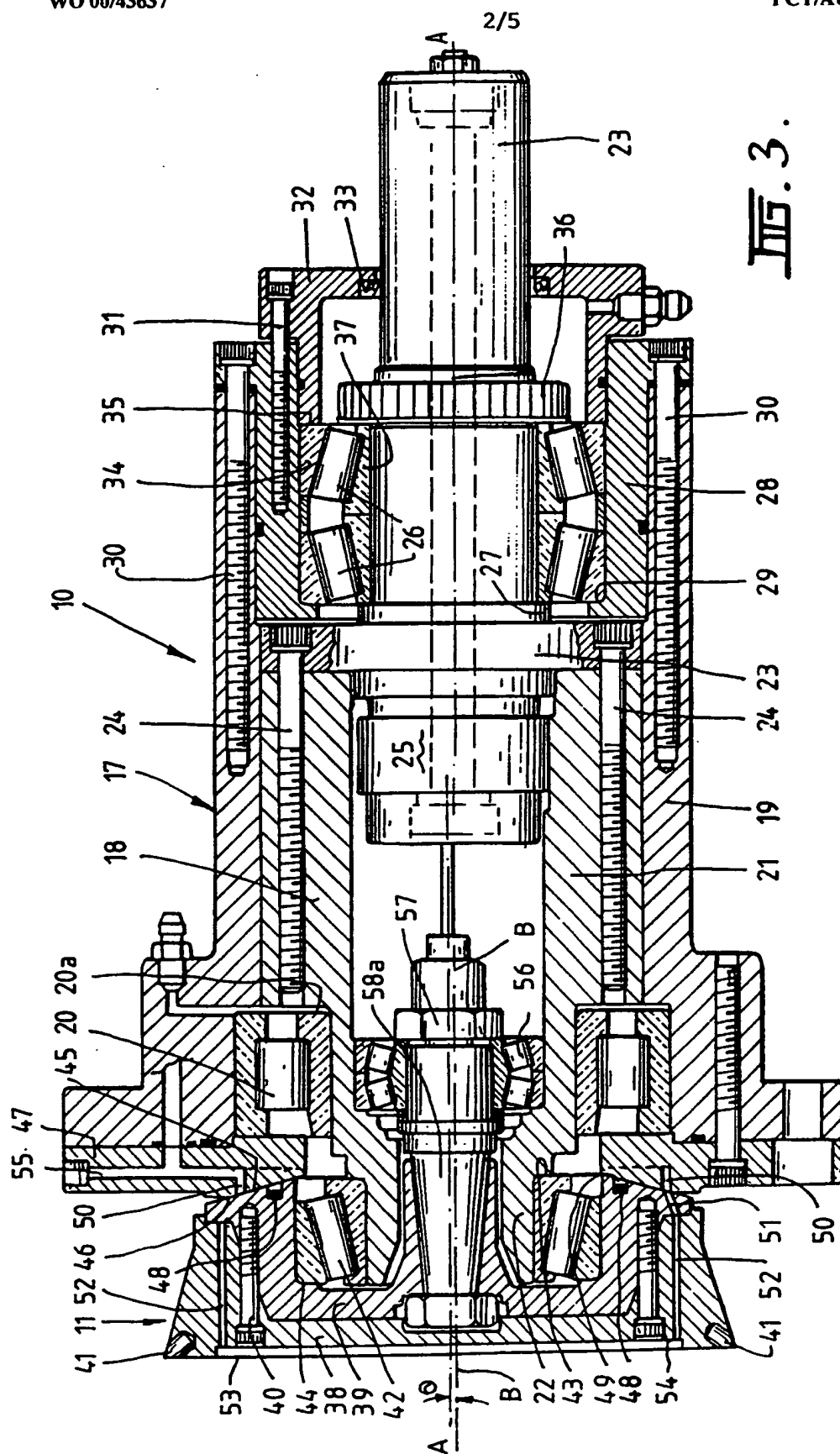
11. A rock boring machine as claimed in any one of Claims 3 to 7, or Claims 9 and 10, wherein a plurality of said rock devices are carried by the machine.

12. A rock boring machine as claimed in any one of Claims 3 to 7, or Claims 9 to 11, wherein the cutter velocity is controlled by interaction with a computer that processes algorithms with variable information input being provided by strain gauges and accelerometers mounted adjacent to the cutter.

13. A rock boring machine as claimed in any one of Claims 3 to 7, or Claims 9 to 11, wherein the vehicle must be anchored or referenced to a position to insure too greater cut is not applied should the vehicle inadvertently move from the position it was in at the commencement of the cutting cycle.

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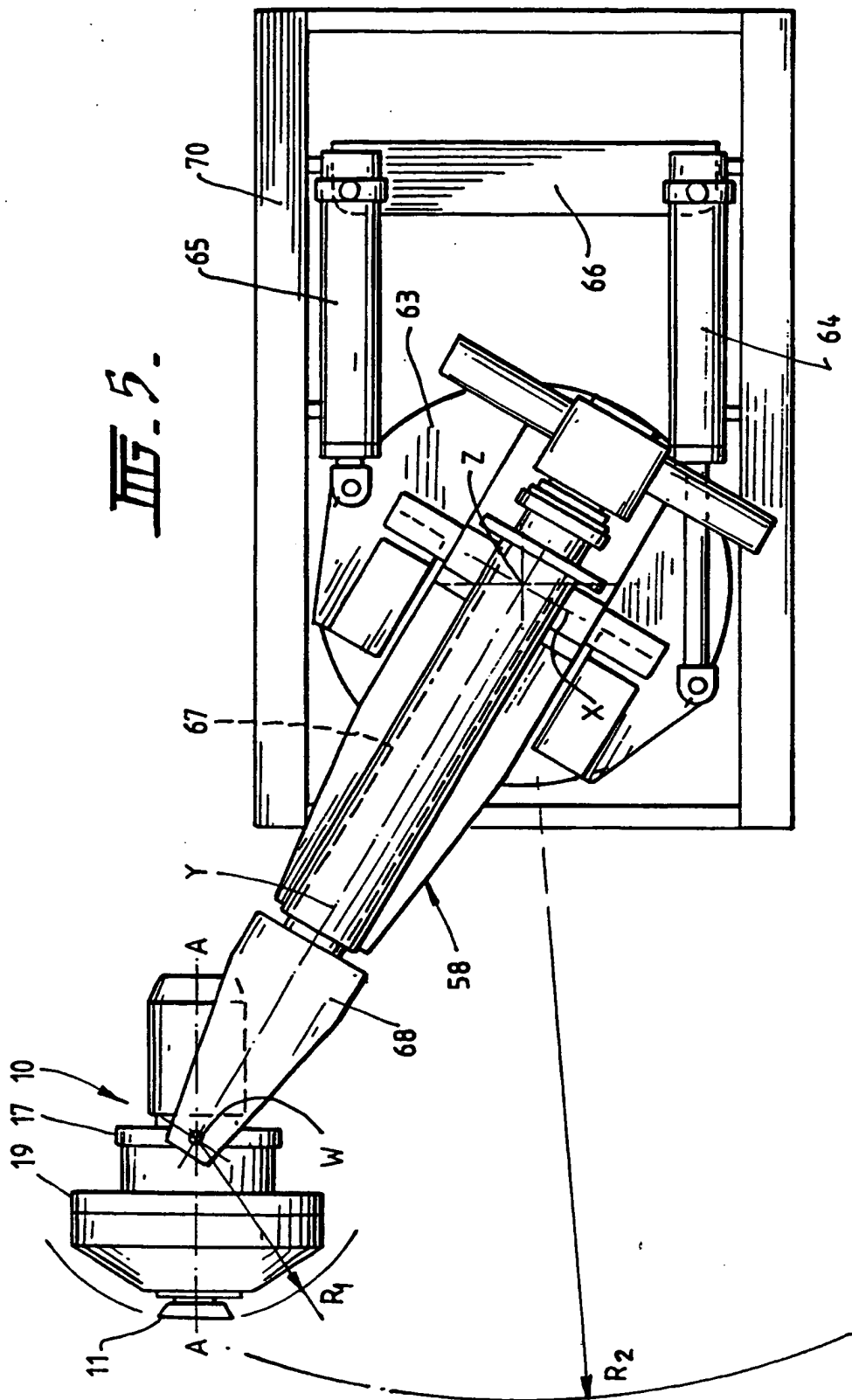
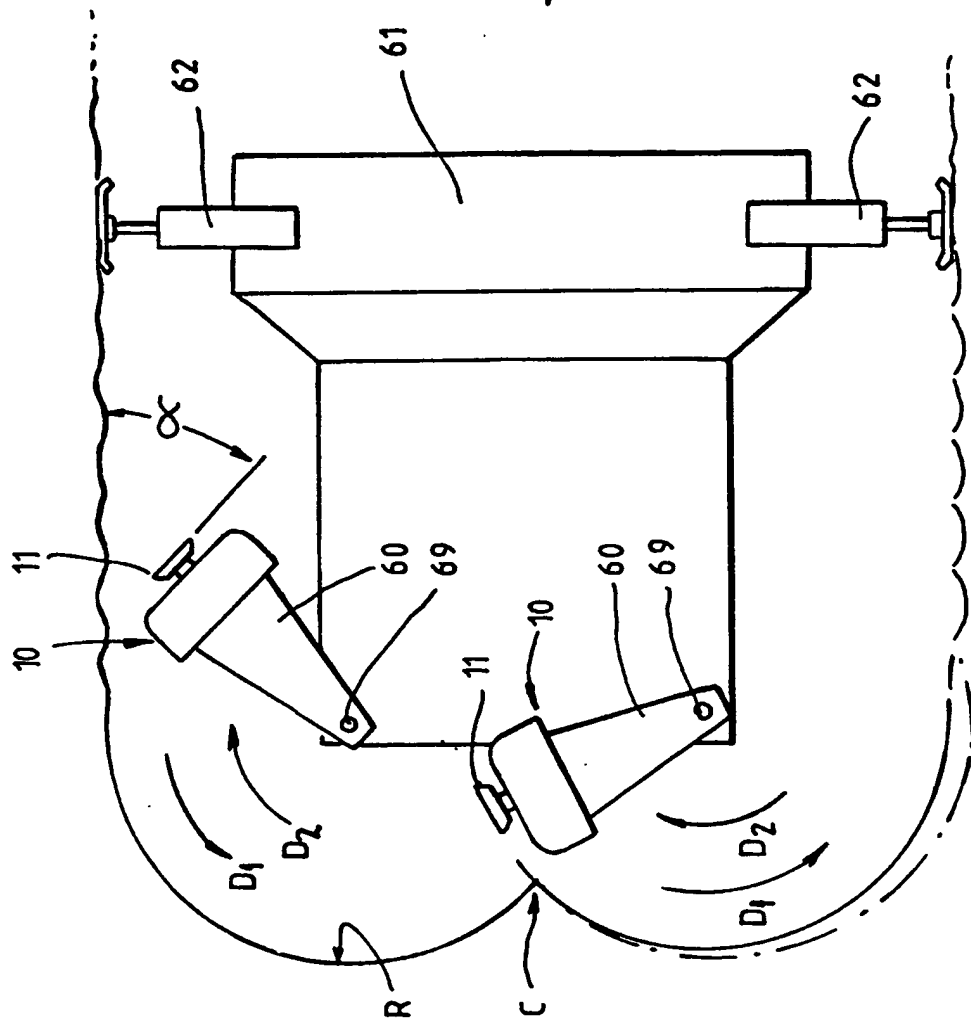


Fig. 6.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU 00/00030

A. CLASSIFICATION OF SUBJECT MATTER		
Int Cl ⁷ : E21D 9/10		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) IPC: E21B 9/10, 9/11 + Keywords		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU: IPC as above		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPAT: oscillat+ or wobbb+ or nutat+ or eccent+ or offcent+ or ellipt		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	AU 41965/72 B (UNION INDUSTRIELLE BLANZY-QUEST) 20 December 1973 see whole document	1
A	US 5575537 A (PETER KOGLER) 19 November 1996 see whole document	1
A	GB 2252576 A (ANDERSON GROUP PLC) 12 August 1992 see whole document	1
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex		
<p>* Special categories of cited documents:</p> <p>"A" Document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>		
Date of the actual completion of the international search 09 February 2000		Date of mailing of the international search report 23 FEB 2000
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No.: (02) 6285 3929		Authorized officer BARRY STEPHENS Telephone No.: (02) 6283 2106

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 00/00030

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 692612 A (BECHEM) 17 January 1996 see whole document	1

Information on patent family members

PCT/AU 00/00030

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report			Patent Family Member				
AU	41965/72	NONE					
US	5575537	DE	4413235	EP	677643	ZA	9502982
GB	2252576	AU	11788/92	US	5338104	WO	92/14035
		ZA	9200802				
EP	692612	CH	689546				